CANADA-WIDE STANDARD FOR BENZENE

- PHASE I

Progress Report 2001

Albaria
ENVIRONMENT

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SUMMARY

At their June 2000 meeting, the Canadian Council of Ministers of the Environment (CCME) ratified the Canada-Wide Standard (CWS) for Benzene Phase 1. Under this agreement, the CCME Ministers are committed to reducing national benzene emissions by 30% between the base year of 1995 and the year 2000. This Progress Report outlines the achievements made to date within the Province of Alberta.

In accordance with the initiatives of Phase 1 of the CWS for Benzene, the Alberta Government has focused on effecting emission reductions in the following three industrial sectors: natural gas dehydrators, petroleum refineries and chemical manufacturing plants. Initiatives to reduce emissions from these sectors have led to a 66% decrease in benzene emissions between 1995 and 1999. Overall, emissions from industry and mobile sources in Alberta have been reduced by 50% during this time period.

Changes in ambient benzene concentrations have also been noted in Alberta since the implementation of the CWS for Benzene. Three urban benzene monitoring stations at Edmonton East, Edmonton Central and Calgary Central have reported reductions of 24%, 29% and 53%, respectively, between 1995 and 2000.

Benzene reductions achieved in Alberta are presented in Table 1.

Table 1 Changes in Industrial Benzene Emissions and Ambient Benzene Concentrations in Alberta Between 1995 and 2000

		1995	2000	Reduction 95-00 (%)
Industrial Emissions	Dehydrators, Refineries & Chemical Plants	7349 tonnes	2522 tonnes*	66*
	All Other Industrial & Mobile Sources	4613 tonnes	3465 tonnes*	25*
	Total Industrial & Mobile	11962 tonnes	5987 tonnes*	50*
Ambient Levels	Edmonton East	2.89 $\mu g\ m^3$	2.21 $\mu g\ m^3$	24
	Edmonton Central	3.13 $\mu g\ m^3$	2.19 $\mu g\ m^3$	29
	Calgary Central	4.29 $\mu g\ m^3$	2.05 $\mu g\ m^3$	53

* 1999 Data

ABBREVIATIONS

AENV	Alberta Environment
BMP	Best Management Practices
CAPP	Canadian Association of Petroleum Producers
CASA	Clean Air Strategic Alliance
CCME	Canadian Council of Ministers of the Environment
CCPA	Canadian Chemical Producers' Association
CPPI	Canadian Petroleum Products Institute
CWS	Canada-wide Standards
ENGO	Environmental Non-Governmental Organisation
EPEA	Environmental Protection and Enhancement Act
EUB	Energy and Utilities Board
LDAR	Leak Detection and Repair
NPRI	National Pollutant Release Inventory
MOU	Memorandum of Understanding
VOC	Volatile Organic Compound

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1.0 INTRODUCTION

Under the Alberta Environmental Protection and Enhancement Act (EPEA), Alberta Environment is responsible for supporting and promoting the protection, enhancement and wise use of the environment. Alberta Environment recognizes that the protection of the environment is essential to the integrity of ecosystems and human health, and to the well-being of society.

The Canada-wide Standard (CWS) for Benzene is to be delivered as a two-phase process. Phase 1, ratified by the CCME in June 2000, commits Environment Ministers at the federal, provincial (excluding Quebec) and territorial levels to achieve 30% reductions in national benzene emissions from 1995 levels by the year 2000. Phase 2, not yet ratified, establishes a 6-kilotonne reduction in national benzene emissions (in addition to the 30% reduction proposed for Phase 1) by 2010. The reductions proposed for both phases are sector specific and account for the relative contribution of each industrial sector toward national emissions. This report focuses exclusively on benzene emission reductions achieved in Alberta due to the implementation of Phase 1 of the CWS.

Under the Canada-wide Environmental Standards Sub-Agreement of the Canada-wide Accord on Environmental Harmonization, provincial responsibilities include:

- providing scientific and technical support to the CWS development process, and;
- implementing measures requiring action from industrial, municipal, and other sectors to attain an agreed-upon Canada-wide Environmental Standard.

Benzene is considered a non-threshold carcinogen. The proposed benzene emission reductions are intended by the CWS Development Committee to be an appropriate step toward the national goal of improving air quality and protecting the health of Canadians. It has been estimated that a decrease in national benzene emissions of 30% between 1996 and 2000 would result in an 18% reduction in ambient benzene concentrations, due to continuous input from non-industrial sources such as biogenic emissions. Implementation of the CWS for Benzene will help the Alberta Government to fulfil its responsibilities of protecting the environment and human health.

The CWS for Benzene will also assist several environmental and industrial groups in Alberta to achieve their environmental goals. For example, the Clean Air Strategic Alliance (CASA), a stakeholder partnership between government, industry and environmental non-governmental organisations (ENGOs), has the vision of ensuring that "the air will be odourless, tasteless, look clear and have no measurable short- or long-term adverse effects on people, animals or the environment" (CASA 2001). Many CASA stakeholders have actively participated in the development of the CWS for Benzene. As a result of the stakeholders' involvement in this process, the CWS targets reflect CASA's vision of a cleaner atmosphere.

The **Canadian Chemical Producers' Association (CCPA)** has the three main objectives of being competitive, responsible and credible. Environmental health and safety issues fall under the objective of being responsible, and are approached through the industry association's Responsible Care ® initiative. This initiative was designed in order for the chemical industry to deal more directly with public concerns over chemicals and their impact on the environment. Through Responsible Care, the chemical industry makes the assertion that safeguarding

employees, the environment and the neighbourhoods they reside in, is of primary concern. The CCPA has agreed that reduction or prevention of emissions of volatile organic compounds (VOC), including benzene, to the environment is warranted to reduce potential health effects due to smog. However, it also asserts that reductions or eliminations must be made using "reasonable, cost-effective measures" (CCPA 2001).

The **Canadian Association of Petroleum Producers (CAPP)** is an industry association that represents companies involved in the exploration, development and production of natural gas and crude oil. CAPP has the vision of "being acknowledged as a credible and responsible contributor to sustainable development" (CAPP 2000). The industry association commits to facilitating and enhancing the "sustainability of the Canadian upstream petroleum industry in a manner that equitably balances the three pillars of sustainable development: the environment, economy and society" (CAPP 2000).

CAPP recognizes the importance of reducing benzene emissions, particularly in situations where workers or the general public are at risk of exposure (CAPP 2001). The association also claims that it is prepared to do its part in reducing benzene emissions to the extent that those emissions present a significant risk to public health, or as part of a comprehensive program involving all other major sources (CAPP 2001). CAPP supports further evaluation of cost-effective technologies as an appropriate measure for reducing benzene emissions from member companies.

The **Canadian Petroleum Products Institute (CPPI)** is an association of Canadian companies involved in the refining, distribution, or marketing of petroleum products. In its mission statement, the CPPI strives to be actively sought and respected by key stakeholders of the petroleum refining and marketing industry in efficiently and effectively achieving its goals. One of the goals highlighted in the Institute's mission statement is to "achieve acknowledgement as an environmentally and socially responsible industry while satisfying customer needs" (CPPI 1999).

Members of the CPPI recognize the need to improve the compatibility of their operations and products with the environment while economically supplying products and services to consumers (CPPI 1999). The CPPI accepts the CWS Phase 1 emission reduction goals as a step toward achieving its mission, and commits to continue working with the CWS Development Committee and provincial regulators toward developing and implementing these guidelines.

2.0 ACTIONS TAKEN

Alberta's implementation of the CWS for Benzene is focused on three industrial sectors, including natural gas dehydrators, petroleum refineries and chemical manufacturing plants. Table 2 presents the instruments used to implement benzene emission reductions.

Table 2 Instruments Used for Implementation of the CWS for Benzene

Industrial Sector	Instrument	Responsibility
Natural Gas Dehydrators	Best Management Practices for the Control of Benzene Emissions from Glycol Dehydrators	Alberta Energy and Utilities Board (EUB)
Petroleum Refineries	CCME Environmental Code of Practice for Measurement and Control of Fugitive VOC Emissions from Equipment Leaks	Alberta Environment (AENV)
Chemical Manufacturing Plants	Memorandum of Understanding Between the Governments of Canada, Ontario and Alberta and the Canadian Chemical Producers' Association on Environmental Protection Through Action Under CCPA Responsible Care ®	Governments of Canada, Ontario and Alberta

The following discussion examines in further detail the actions taken in each sector and the resulting changes in benzene emissions.

2.1 Natural Gas Dehydrators

Control Measure Applied	Result
Best Management Practices for the Control of Benzene Emissions from Glycol Dehydrators.	Decrease of 4814 t between 1995 and 1999.

The Canada-wide Standard for Benzene, Phase 1, called for a 60% decrease in national benzene emissions from natural gas dehydrators between 1995 and the end of 2000. In 1995, 82% of Canada's natural gas dehydrators were located in Alberta.

The instrument proposed by the CWS Development Committee for reducing emissions from natural gas dehydrators was implementation of the Best Management Practices (BMP) for the Control of Benzene Emissions from Glycol Dehydrators. In compliance with the necessary actions outlined for each jurisdiction, the Alberta Energy and Utilities Board (EUB) issued Informational Letter IL 97-04 on 17 November, 1997. This document announced a program to reduce benzene emissions from dehydrators through voluntary actions consistent with the BMP, to begin 1 January 1998. The voluntary actions undertaken by dehydrator operators were as follows:

- Implementation of an emission reduction schedule including regular reporting;
- Emissions of not more than 9 t per year per facility by 1 January, 1999;
- Emissions of not more than 5 t per year per facility by 1 January, 2001;
- Emissions of not more than 3 t per year per facility by 1 January, 2001 for facilities located within 0.75 km of a residence;
- Emissions of not more than 3 t per year per facility for those commissioned between 1 January, 1999 and 1 January, 2001;
- Addressing of potential risks from benzene emissions by operators in resident communications;
- Submission of a comprehensive report by 1 March, 2001;
- Assessment of industry's performance by a Technical Advisory Team in 2001 to review the need for more formal regulation.

On 14 August 2001, the EUB released Informational Letter 2001-07, a Revised Program to Reduce Benzene Emissions from Glycol Dehydrators (EUB 2001). The purpose of this document was to introduce the Best Management Practices for the Control of Benzene Emissions from Glycol Dehydrators document, as updated in December, 2000. It was noted in IL 2001-07 that the voluntary industry program has reported exceeding targets for reducing benzene emissions. The EUB further indicated support of the voluntary program without more formal requirements, provided that oil and gas operators comply with procedures and processes outlined in the revised BMP.

2.2 Petroleum Refineries

Control Measure Applied	Result
CCME Environmental Code of Practice for Measurement and Control of Fugitive VOC Emissions from Equipment Leaks.	Decrease of 14 t between 1995 and 1999.

The CWS for Benzene, Phase 1, called for a 43% decrease in national benzene emissions from refineries between 1995 and the end of 2000. In 1995, 5 of Canada's 25 refineries reporting to the National Pollutant Release Inventory (NPRI) were located in Alberta.

As a necessary action for implementing benzene emission reductions from petroleum refineries, the CWS Development Committee called for modification of the CCME Environmental Code of Practice for Measurement and Control of Fugitive VOC Emissions from Equipment Leaks, created in October of 1993. The approach suggested by the Code of Practice as a means of controlling fugitive emissions is as follows, by order of priority:

- prevention by the selection of non-leaking or leak-tight equipment;
- monitoring for detection of leaks;
- reparation as promptly as possible (Leak Detection and Repair, or LDAR);
- continuous upgrading or leak prevention achievements.

The Code of Practice is implemented by AENV during its review of petroleum refineries, to ensure that appropriate technology is being used in the refining process.

In April of 1998, the CPPI issued the Guideline for Measurement and Control of Fugitive Hydrocarbons Emissions, as means for effecting VOC emission reductions from Canadian refineries. In this document, the CPPI recommended that member companies' refineries adopt the provisions of the aforementioned CCME Environmental Code of Practice within three years of the adoption of the CPPI Guideline.

2.3 Chemical Manufacturing Plants

Control Measure Applied	Result
Memorandum of Understanding Between the Governments of Canada, Ontario and Alberta and the Canadian Chemical Producers' Association on Environmental Protection Through Action Under CCPA Responsible Care ®.	Increase of 1 t between 1995 and 1999. **NB:** Increases in benzene emissions are due to production expansion in the chemical industry in Alberta.

The CWS for Benzene, Phase 1, called for a 70% decrease in national benzene emissions from chemical manufacturing plants between 1995 and the end of 2000. In 1995, 24 of Canada's 123 inorganic and organic chemical manufacturing plants reporting to the NPRI were located in Alberta.

The proposed instrument for reducing benzene emissions from chemical manufacturing plants is modification of the existing Memorandum of Understanding (MOU) between Environment Canada and the Canadian Chemical Producers Association, to be approved as well by the Alberta and Ontario Governments. The objective of the MOU is to prevent and reduce the release of chemical substances through voluntary, non-regulatory action under CCPA Responsible Care ®. The new MOU provides specific reduction targets and timelines with regard to emissions of VOCs. Specifically, the MOU calls for a 70% reduction in benzene emissions by 2001. The new MOU is currently awaiting ministerial approval, but is being implemented by CCPA members.

Another identified action for reducing benzene emissions from chemical manufacturing plants is implementation of the CCME Environmental Code of Practice for Measurement and Control of Fugitive VOC Emissions from Equipment Leaks. The actions suggested in this document for controlling fugitive emissions from chemical manufacturing plants are the same as those for petroleum refineries (see previous section).

2.4 Alberta Ambient Air Quality Guidelines

Through the Environmental Protection and Enhancement Act, Alberta Environment has established Ambient Air Quality Guidelines for several important chemicals. These guidelines were developed to ensure that emissions are minimised through the use of Best Available Demonstrated Technnology, and that emissions are dispersed to acceptable levels for humans and the environment. Alberta Environment incorporates these guidelines into the writing of regulatory approvals to ensure that individual facilities are complying with the stringent

emissions controls. The Ambient Air Quality Guideline for benzene is 30 $\mu g/m^3$ as a one-hour average.

2.5 Alberta's Achievements

The Alberta Government's initiatives aimed at reducing benzene emissions have resulted in a number of important changes. Most notably, the province has experienced a decrease in combined emissions from natural gas dehydrators, petroleum refineries and chemical manufacturing plants from 7349 t in 1995 to 2522 t in 1999, representing a reduction of approximately 66%.

In addition to the three sectors of primary interest to the CWS development committee, benzene emission reductions were achieved for many other sectors in Alberta. Based on available and estimated emissions data, a decrease in total benzene emissions, from approximately 11962 t in 1995 to 5987 t in 1999, was noted. This represents an approximate 50% reduction in total benzene emissions within the province. Emissions data for industrial sources are presented in Table 3.

Table 3 Benzene Emissions from Alberta Sources in 1995, 1999 and 2000

Industrial Sector	1995		1999	
	No. of Facilities	Emissions (t)	No. of Facilities	Emissions (t)
Natural Gas Dehydrators	2410	7240	3127	2426
Petroleum Refineries	5	39	5	25
Chemical Manufacturers	24	70	21	71
Conventional Oil & Gas	49	253	57	142
Non-Conventional Crude Oil	4	96	4	75
Lube Oil & Grease	ND*	ND	1	2
OSB Mills	3	26	ND	ND
Mobile Sources (incl. Fuel distribution)	ND	4238**	ND	3246***

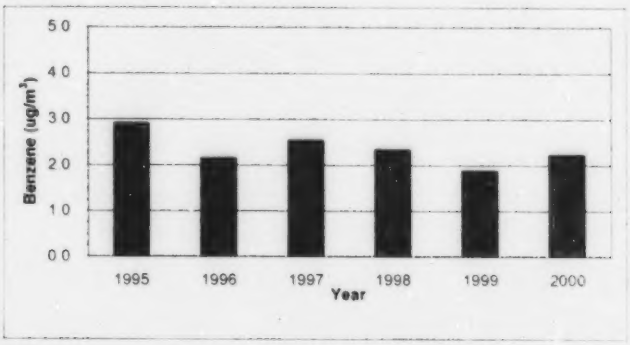
* ND: No data available for indicated year and or industrial sector.
** 1994 NPRI estimate.
*** 2000 estimate based on estimated national decrease of 23% between 1994 and 2000 (CCME 2001c).

3.0 AMBIENT BENZENE LEVELS

Environment Canada has operated a national field measurement program for benzene and other VOCs in ambient air since 1989 (Dann, 1999). In Alberta, ambient atmospheric benzene concentrations are measured at three urban sites - Edmonton East, Edmonton Central and Calgary Central.

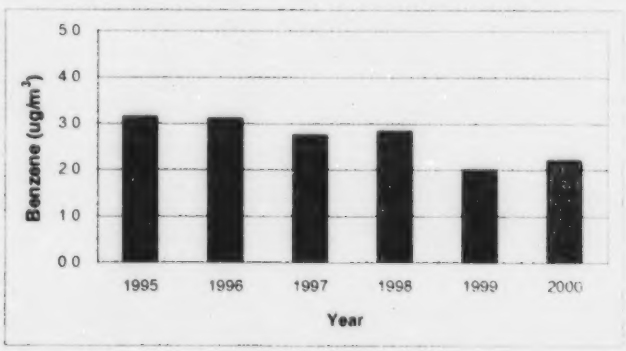
Average ambient benzene concentrations at the Edmonton East station decreased from 2.89 $\mu g/m^3$ in 1995 to 2.21 $\mu g/m^3$ in 2000, representing a 24% decrease during that time period (Figure 1).

Figure 1 Ambient Benzene Concentrations at the Edmonton East Station



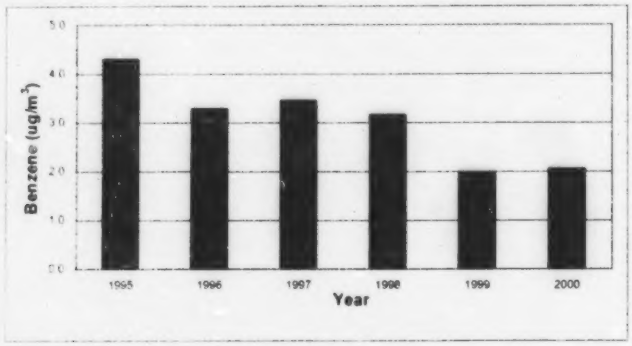
Similarly, average ambient benzene concentrations at the Edmonton Central station decreased by 29% between 1995 and 2000, from 3.13 $\mu g/m^3$ to 2.19 $\mu g/m^3$ (Figure 2).

Figure 2 Ambient Benzene Concentrations at the Edmonton Central Station



Data from the Calgary Central station showed a decrease in average ambient benzene concentrations from 4.29 $\mu g/m^3$ in 1995 to 2.05 $\mu g/m^3$ in 2000, representing a 53% reduction during this time period (Figure 3).

Figure 3 Ambient Benzene Concentrations at the Calgary Central Station



Average ambient benzene concentrations from these three stations are summarised in Table 4.

Table 4 Ambient Benzene Concentrations in 1995 and 2000

Ambient Monitoring Station	Site Classification	Annual Average for 1995 ($\mu g/m^3$)	Annual Average for 2000 ($\mu g/m^3$)	Reduction 1995 – 2000 (%)
Edmonton East	Urban	2.89	2.21	24
Edmonton Central	Urban	3.13	2.19	29
Calgary Central	Urban	4.29	2.05	53

Although trends in ambient benzene concentrations have been shown based on one-year averages, it is important to note that trends are more typically based on five-year averages. Averaging concentrations over five years eliminates the influence of meteorological variations on emissions and ambient concentrations alike. Because annual reporting of the CWS for Benzene requires a comparison of ambient levels between consecutive years, minor increases or decreases in ambient benzene levels may be a result of such factors as meteorological conditions.

The ambient benzene monitoring stations used in this analysis are located within urban centres, while the majority of industrial facilities are operated in rural areas. Because of the distance between benzene sources and ambient monitoring stations, it is not possible to draw conclusions linking emission reductions and decreases in ambient levels. In order for this analysis to be complete, there are several data gaps that must be filled.

4.0 CONCLUSIONS

This report was prepared in compliance with the jurisdictional responsibilities outlined for the development and implementation of the Canada-wide Standard for Benzene. It presents initiatives undertaken by the Alberta Government and stakeholder groups within the province to reduce benzene emissions from industrial processes.

The CWS for Benzene calls for a 30% reduction in national benzene emissions from 1995 levels by the year 2000. Under the CWS implementation strategy, the Alberta Government is responsible for regulating benzene emissions from the following industrial sectors: natural gas dehydrators, petroleum refineries and chemical manufacturing plants. Overall, benzene emissions from these three sectors have been reduced by 66% between 1995 and 1999. Emissions from all major sources of benzene in the province have decreased by approximately 50% in this time period. In addition to emissions reductions, ambient benzene concentrations at three stations in the major centres of Edmonton and Calgary have experienced reductions of 24%, 29% and 53%.

Benzene emission reductions taking place in Alberta have reduced the level of human exposure to this known carcinogen. The Alberta Government will continue to support the implementation of the Canada-wide Standard for Benzene as it moves into its next phase.

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